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THE

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PROCEEDINGS OF THE AMERICAN SOCIETY OF ZOÖLOGISTS.

FIRST ANNUAL MEETING OF THE EASTERN BRANCH.

THE first annual meeting of the Eastern Branch of the American Society of Zoölogists, the fourteenth annual meeting of the Society since its establishment as the American Morphological Society, was held in Biological Hall, University of Pennsylvania, Philadelphia, Pa., on Tuesday and Wednesday, December 29 and 30, 1903.

In accordance with the report of the committee appointed at the preceding meeting to consider the matter of the publication of the proceedings of the Society, of an official organ, etc., it was voted to be the sense of the Eastern Branch of the American Society of Zoölogists that the *American Naturalist* should become the official organ of the Society, and the committee was empowered to arrange for the publication of this year's proceedings of the Eastern Branch in the *American Naturalist*.

The committee in charge of the preparation of an invitation to the International Zoölogical Congress to hold its meeting in 1907 in America, presented its report, which was adopted. As the result of this action, and similar action by the Central

Branch, the American Society of Zoölogists will invite the International Zoölogical Congress to meet in America in 1907. The necessary preliminary arrangements have been left to a committee. The committee appointed to draw up a definition of zoölogical requirements for admission to college, conformable with the definition of the requirements in other sciences, published by the College Entrance Examination Board, submitted a report of progress that caused considerable discussion, and the committee was continued.

The list of officers for 1904 is as follows:

President, E. A. Andrews; vice-president, W. E. Castle; secretary-treasurer, G. A. Drew. Additional members of the executive committee, T. H. Montgomery, Jr., H. C. Bumpus, H. S. Jennings.

The following are abstracts of papers presented at the meeting:

The Egg Cases of Chimæroid Fishes: Bashford Dean, Columbia University. — The egg cases of chimæroid fishes present an extreme case of adaptation, not to the egg of the time it is placed in the capsule, but to the young fish when about to escape. From this standpoint the capsule is adapted in the matter of extreme size, definite modeling to the head, trunk and tail of the young fish, durability, mode of attachment, position, which enables the young fish to develop dorsal side upward, orientation, wherein the snout of the young fish develops in the direction of the opening valve, and the tail in the direction of the long and narrow end of the capsule. Further adaptations include an elaborate provision for circulation of water within the capsule, the mechanism for which improves as the embryo develops, by means of a process of weathering, whereby the perforations of the capsule become progressively larger; and a special exit valve which can be opened only from within, and only at the time when the fish is ready to escape. The exit valve has then a kind of tension resulting in "dehiscence," comparable somewhat to that of the elements of a seed pod. Adaptation is made still more complete by provision for the specific characters of the adult; thus the species which have the longest tails have the longest tail sheaths in the egg capsules, and those having the deepest bodies have also the deepest cavity in the main portion of the capsule.

The foregoing characters evidently cannot be explained by the Lamarckian hypothesis, for so perfect a case could not have been formed primitively *in utero* around the embryo; for, by the principle of use and disuse itself, such an elaborate capsule would not have been formed for the protection of an embryo which was just about to be hatched, nor would the capsule be provided for aquatic breathing. It is, moreover, a well known law that in uterine development the secondary membranes are reduced rather than increased. Natural selection, as it is generally understood, is equally inadequate to explain the formation of the present capsule; for, from this standpoint, fluctuating variations would have had to be selected throughout a long series of complicated changes in two entirely different lines, *i. e.*, in the line of the evolution of the embryo and in that of the evolution of the capsule. And it is more than difficult to imagine that in each of these parallel series the corresponding favorable fluctuations could have continued to be successively selected. This series of constantly adapted stages furnishes a notable example of development in a definite line.

The Reproductive Organs of the Limbless Lizard Anniella: W. R. Coe and B. W. Kunkel, Yale University.— The subject of this investigation, *Anniella pulchra*, lives on the barren sand plains in certain portions of California and Arizona. It is a slender, worm-like lizard, entirely devoid of limbs and limb girdles except for slight rudiments of the pelvic arch. It lives beneath the surface of the sand and feeds upon small insects and spiders.

Although described in 1852, it has never been carefully studied except with regard to its external anatomy and skeleton.

An examination of its viscera reveals a number of interesting anatomical peculiarities, among which those of the reproductive organs are perhaps the most striking. These relate particularly to the oviducts and uterus of the female and the copulatory organs of the male.

As in many other lizards, Anniella is ovoviviparous. The young, only two of which are produced in a season, are born in

September. Both of these develop in the right oviduct (Fig. 1, *ut*, *ut'*), the left being very rudimentary and apparently quite functionless (Fig. 1, *l. od*). The right and left ovaries are equally well developed and a single ovum matures in each, but both ova enter the right oviduct.

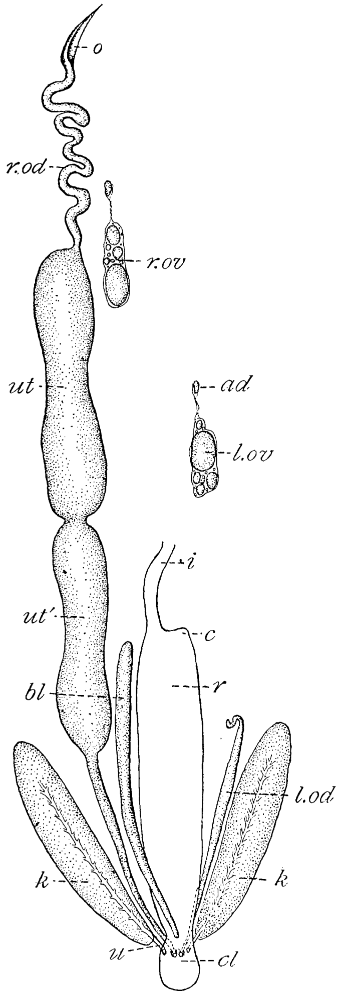

FIG. 1.—Diagram of the urogenital organs of Anniella, showing the right oviduct (*r. od*) with the two developing embryos (*ut*, *ut'*) in the uterus, the rudimentary left oviduct (*l. od*), and the ovaries (*l. ov* and *r. ov*); *ad*, adrenal body; *o*, ostium of right oviduct; *bl*, urinary bladder; *k*, kidney; *u*, ureter; *cl*, cloaca; *i*, ileum; *c*, rudimentary cæcum; *r*, rectum. × 3.

The rudimentary left oviduct is represented by a slender tube usually extending forward only about as far as the anterior ends of the kidneys, which are situated in the most posterior por- the body cavity (Fig. 1, The anterior end of this oviduct is terminated ery narrow canal which shows a tendency to become more or less convoluted. It is especially noteworthy that this convoluted, terminal canal shows great variation in length in different individuals. In a single specimen examined it was about half as long as that of the functional right oviduct. In this single instance the rudimentary oviduct is terminated anteriorly by an ostium opening into the body cavity. The posterior end of the left oviduct is but little smaller than that of the right, and has a similar structure and similar relations with the cloaca.

These peculiarities furnish a striking example of what appears to be a very recently acquired anatomical character — one which has not reached a condition of stable equilibrium, as instanced by the great variation of the parts concerned. The left oviduct has apparently been eliminated as a functional organ of the body, and yet the case mentioned where it was half as long as the functional one suggests the possibility of further variations, which, in an exceptional case, might show a reversion to the primitive condition in which an embryo might develop in this now rudimentary organ.

So far as we are aware no instance of an aborted and functionless oviduct has been reported for any of the lizards. The related genus, Anguis, of Europe, has both oviducts well developed. In many reptiles, however, the left is shorter than the right oviduct, so that Anniella presents a variation along the same line as these other reptiles, but one which has been carried to an extreme condition.

It should be pointed out that it is the left oviduct which is aborted in Anniella, while it is the right which has become functionless in birds. In the latter, however, the degeneration of the parts is carried to a greater length in that the right ovary is likewise more or less aborted, while in Anniella both ovaries retain their normal functions.

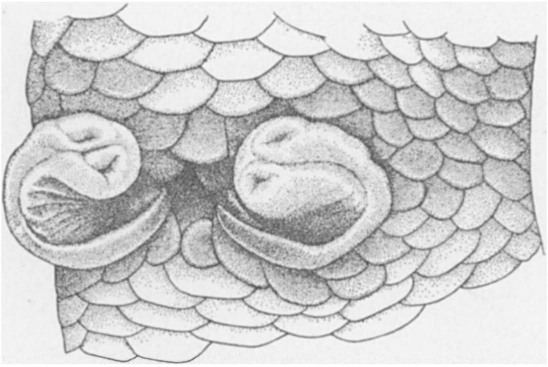

FIG. 2.— Portion of ventral surface of embryo of Anniella shortly before birth, showing the pair of large copulatory organs (phalli) projecting from the lateral borders of the cloacal aperture and the oblique groove and terminal pits with which each phallus is provided. × 22.

In the male the spermaries and the sperm ducts are developed equally on the two sides of the body. The copulatory organs (phalli) are formed as finger-like, external projections from the lateral borders of the cloacal aperture, and nearly to the time of birth have a curious resemblance to a pair of rudimentary limbs (Fig. 2). Shortly before birth they are drawn into the cloacal aperture, and by a process of invagination are converted into a pair of slender pouches which extend backward into the caudal region for a considerable distance behind the cloaca. They then lie on the ventral side of the tail and immediately internal to the muscles of the integument.

It is a remarkable fact that these copulatory organs develop in females as well as in males. In females, however, they cease their development after they are converted into post-cloacal pouches, although they are retained throughout the life of the animal. In the males, on the other hand, they increase greatly in size at the time of sexual maturity. During the act of copulation the large blood sinuses with which they are provided become distended with blood. This surcharging with blood, together with the contraction of certain muscles which surround the pouches, causes the phalli to be everted to their original, embryonic condition, and thus to function as a pair of true copulatory appendages.

Some Account of the Temporary Biological Station at Bermuda for the Season of 1903: Charles L. Bristol, New York University.— The following invitation was issued about May 1, 1903:

Harvard University and New York University unite with the Bermuda Natural History Society in inviting botanists and zoölogists to spend six weeks in the temporary biological station provided for the present season at Bermuda.

By special arrangements with the Quebec S. S. Co. and the Hotel Frascati it has been possible to make the total expense, including transportation from New York and return, and board and lodging for six weeks at Bermuda, one hundred dollars.

The Bermuda Natural History Society has expressed its intention to do everything in its power to make the summer's work as profitable and pleasurable as possible, and to this end has undertaken to provide, among other things, the necessary facilities for collecting, namely, a steam launch, thirty to forty feet long, with crew; a sail boat with fish-well and crew; three rowing boats, and a carriage with two horses, capable of carrying ten or twelve persons. The laboratory will be equipped with all necessary reagents and utensils except microscopes and dissecting instruments, which should be brought by each investigator.

The well known richness of the sub-tropical fauna and flora, the healthfulness and equable temperature of the islands, and the ease with which they may be reached combine to make the Bermudas a most attractive field for biological research.

Venerable George Tucker, Archdeacon, President Bermuda Natural History Society.

Hon. W. Maxwell Green, Consul U. S. A., Vice-president B. N. H. S.

F. Goodwin Gosling, Honorary Secretary B. N. H. S.

E. L. Mark, Director of Zoölogical Laboratory, Harvard University.

C. L. Bristol, Professor of Biology, New York University.

It met with a hearty reception, and in response to it thirty-three botanists and zoölogists from widely scattered portions of the United States availed themselves of the opportunity offered. The committee in charge was somewhat embarrassed at first, as our temporary laboratory was equipped for twenty research students, but the proprietor of the Hotel Frascati kindly gave up two large rooms in the hotel so that all were comfortably cared for.

The facilities provided and paid for by the Bermuda Natural History Society enabled the party to make daily excursions either by launch to the reefs and lagoons, by wagons to botanical collecting localities, or by rowboat to the nearby places.

During the season Capt. W. E. Myers of St. George placed his powerful sea-going tug, "Gladisfen," at the disposal of the expedition to collect on the "Challenger" bank. The trip occupied three days and was very fruitful in results.

During the stay of the party, between June 22 and August 22, the weather was pleasant save one or two days of dead calm, when it was disagreeably warm, though at no time did the thermometer go above 85° F. The general health of the party was excellent, and demonstrates what my experience had led me to believe, — that the climate is favorable for college workers in midsummer.

The accommodations at Hotel Frascati were excellent. Our party so nearly filled the house that the proprietor, Mr. Alonzo Peniston, put it practically at our disposal, accommodating his meals to our excursions whenever it was desired. The table was first-class, and not to be compared with the usual summer board at seaside laboratories. The food was well cooked, was abundant, and well served at tables always decked with a profusion of flowers.

The party was welcomed on its arrival at the dock by the venerable Archdeacon Tucker, Hon. W. Maxwell Greene and Mr. F. Goodwin Gosling, and this welcome was continued by every one — high and low — during the season. His Excellency, the Governor, Gen. H. LeG. Geary, was kind enough to extend a hearty welcome to the party by holding a reception at Mt. Langton, to which nearly two hundred guests were invited. Hospitality was extended on all sides, and almost to the embarrassment of the work at times.

The people of Bermuda became interested in the annual visits of the New York University Biological Expeditions from 1897 to 1902, and in 1902 a committee of the Legislature was appointed to consider and report on the advisability of the establishment of a Marine Biological Station. The Colonial Secretary, by direction of His Excellency the Governor, addressed a letter asking for information and coöperation to the following: the British Association for the Advancement of Science, the Carnegie Institution, the Royal Society, the Minister of Marine and Fisheries, Canada, Dr. Auton Dohrn, Naples. The responses were all heartily in favor of the idea, and this encouraged His Excellency to ask the approval of the Imperial Government. This was granted in a despatch from the then Secretary of State for the Colonies, Hon. Joseph Chamberlain, and the way was clear for further action by the Colony. In November, 1903, Governor Geary sent a message to the House of Assembly which has resulted in appropriate legislation without a dissenting voice.

It may be safely said now that before long a well equipped station will be available for biologists at Bermuda that will be open the year round.

During the coming summer another "temporary" station will be established and good facilities offered for advanced workers.

A Key to the Development of Sipunculus nudus[1]*:* John H. Gerould, Dartmouth College.— The development of Phascolosoma shows that the embryonal envelope or serosa of *Sipunculus nudus,* described by Hatchek, is a modified prototroch. In the gastrula stage of each form the prototroch consists of two or three rows of broad, flat cells which encircle the embryo. In the trochophore of *Ph. vulgare* the apical plate, the mid-dorsal cord of ectoderm in the interruption of the prototroch and the somatic plate are strikingly similar to the corresponding parts in *S. nudus,* but in the former no sinking beneath the vitelline membrane occurs, and no amniotic cavities are formed. The resemblance between the trochophores extends even to the apical rosette and to the cells which bear the postoral circlet of cilia.

The remnants of the prototroch of Sipunculus are cast off with the vitelline membrane, the huge prototroch cells of Phascolosoma degenerate during metamorphosis, and their substance, in the form of yolk granules passes backward into the newly formed cœlom. Thus the cœlom of the larva becomes filled with yolk granules, which Selenka mistook for blood corpuscles. These gradually are absorbed. A cuticula is formed beneath the vitelline membrane, the latter is shed, and an overgrowth of the region vacated by the prototroch cells takes place.

Sipunculids are primitive Trochozoa, closely allied to chætopods. The adult sipunculid retains the retractor muscles and nephridia of the trochophore; and the loss of the prototroch, development of the cœlom and elongation of the trunk are the only fundamental changes which the trochophore undergoes in passing into the adult form. Resemblance of the trochophore of Phascolosoma to that of chætopods, *e. g.*, Amphitrite, is striking. Transitory metamerism of the mesoblastic bands and of the fundament of the nerve cord in *Ph. gouldii*, immediately before metamorphosis, points definitely to an intimate relationship between the sipunculids and the annelids. Sipunculus is more highly modified than Phascolosoma.

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[1] The reader is referred, for a more complete account, to Studies on the Embryology of the Sipunculidæ. I. The Embryonal Envelope and its Homologue. *Mark Anniversary Volume.* Cambridge, Mass., 1903; and The Development of Phascolosoma (preliminary note). *Archives de Zoöl. expér. et gén. Notes et Revue.* 4e série, T. 2, No. 2, 1904. p. xvii–xxix.

Divergence Under the Same Environment as Seen in the Hawaiian Snails: John T. Gulick, Oberlin, Ohio.— The Island of Oahu presents two mountain ranges; one near the northeast coast, about 35 miles in length, and enjoying a heavy rainfall, especially on the side of the range most exposed to the northeast trade-winds; the other, near the southwest coast, about half as long, and receiving much less rain. The forest regions on these two mountain ranges are occupied by about 300 species of snails belonging to eight genera of the family Achatinellidæ. A large majority of these species belong to four genera found always on the trees or other vegetation. Auriculella clings to the leaves, is about the size of a grain of wheat, and is represented by one abundant species on the dry mountain range, and by several species on the other range. Apex is from half an inch to an inch in length, and occupies the dry range, and the drier ridges of the other range. Achatinella and Bulimella are in size not very different from Apex, and like it are found on the trunks and branches as well as on the leaves; but their distribution is almost entirely on the longer mountain range, Achatinella being more abundant on the less rainy side, and Bulimella prevailing on the more rainy side.

Natural selection has undoubtedly been an important factor in adapting Bulimella for the rainiest districts; and Achatinella and Bulimella for the shady groves of the less rainy region, and Apex for the driest region as well as for the deficient shade on the ridges of the intermediate region.

But we come now to species whose divergence refuses to be explained by either natural selection or sexual selection. As an example of divergent evolution that must depend on other controlling principles, let us consider the formation of the series of species of Achatinella occupying the valleys on the southwest side of the main mountain range. The temperature, the rainfall, the soil, and the plant and animal species surrounding these snails are much the same.

Commencing at the most eastern of these valleys and proceeding toward the northwest, we find that the first seven or eight miles brings us past about that number of deep valleys, occupied by shady groves and inhabited by many varieties belonging to fifteen or more species. These species are all of the larger type of the genus, being near an inch in length. With some of them, all the individuals of the species are found in the groves of a single valley, and in the case of most, even stragglers are not found at a distance of more than a mile from the metropolis of the species.

Proceeding toward the northwest, we find that the genus is represented by many species, of progressively diminishing size, till at the other end of the mountain range the shells have dimensions not more than half those presented by the shells found in the valleys first explored. The habits of feeding are also wholly different; for as we approach the northwest end of the range we find that the larger trees have been deserted, and the shrubs and herbs have become the homes of most of the species. This diversity either in the inherited aptitudes or in the acquired habits of the isolated groups of one stock, resulting in different methods of dealing with the same environment, undoubtedly results in different forms of selection helping to mould the different groups into different species. We, however, note that, in these cases, the process is not natural selection; for it is not difference in the environment causing the accumulation of divergent adaptations, but it is slightly divergent adaptations, protected by isolation from the swamping effects of free-crossing with the original stock, that initiates divergent methods of dealing with the same environment, and so determines the difference in the selection which emphasizes the divergence. This form of selection, determined by the aptitudes and habitudes of the species in dealing with the environment, I call endonomic selection.

A point of very great interest is the important part filled by isolation in producing divergent forms of endonomic selection. If a pair of individuals from a plastic (or variable) species are completely isolated from the original stock, the probability is that in some way their method of dealing with the environment will differ from the method prevailing in the original home, though under certain circumstances it may have been tried by some of the original stock. New relations having been established with the environment, and the swamping effect of association and intergeneration being removed, divergent evolution is insured. Two genera of the Achatinellidæ are found almost exclusively on the ground among the dead leaves. The divergence between these genera living on the ground and those living on the trees and shrubs was probably gradually introduced in some such way. In the same way may have arisen the differences between the genus of minute species feeding on the leaves and the genera of larger forms feeding on what is found on the trunks and branches of the trees.

The Function of the Lateral Line Organs in Fishes: G. H. Parker, Harvard University.—This work was carried on at the Biological Laboratory of the United States Bureau of Fisheries at Woods Hole, Massachusetts. Tests were made on smooth dogfish, skates, winter flounders, scup, and two species of Fundulus. The action of the lateral line organs was eliminated by cutting the branches of the fifth, seventh, and tenth nerves supplied to these organs. After recovery from shock the reactions of individuals on which these operations had been carried out were compared with those of normal fishes. No significant differences could be discovered in the reactions of normal and operated fishes to the following stimuli: temperature changes from 9° C. to 30° C.; salinity changes having a range between a mixture of one part sea water and four parts fresh water, and sea water concentrated to three fourths its original volume; reduced oxygen supply; increased carbon dioxide; foul water; reduction of pressure to nine pounds; increase of pressure to twenty-two pounds; and currents of water. On testing for equilibrium it was found that the lateral line organs were of no more significance in this respect than the general integument. Normal and operated fishes did not respond differently to sound vibration of the rate of 100 per second. Operated fishes failed to respond to vibrations at the rate of six per second, whereas normal fishes reacted to these with great precision. The lateral line organs are, therefore, concerned with vibrations of low frequency. These vibrations are often produced when large objects move in the water or when wind blows on its surface.

The Sexual Elements of the Giant Salamander: Albert M. Reese, Syracuse University. — Eggs and spermatozoa were obtained by stripping giant salamanders (*Cryptobranchus allegheniensis*) during the latter part of September.

Each egg is a spherical mass of yellow yolk, about 6 mm. in diameter, surrounded by two layers of transparent jelly; it does not completely fill the inner envelope, but is surrounded by an aqueous fluid.

The egg proper is filled with yolk granules of various sizes, and is surrounded by a thin vitelline membrane.

The gelatinous envelopes are continued as slender cords from egg to egg, forming a continuous string similar to the egg-strings of Amphiuma. The distance between two adjacent eggs is about four or five times the diameter of a single egg.

Some dozens of eggs were obtained from one female, all of them apparently being derived from one ovary.

The spermatozoa, in which no motion could be seen, though stripped with little difficulty from the males, consist of an elongated, cylindrical nucleus, a sharp, gradually-tapering apical body, and a tail of moderate length which consists of a central fibre and a transparent envelope. No middle-piece can be made out.

Artificial fertilization was attempted but was entirely unsuccessful.

Some Recently Discovered Cases of Mutual Sexual Adaptation: P. P. Calvert, University of Pennsylvania. — In studying the Odonata of Mexico and Central America for the *Biologia Centrali-Americana* it was found that a new species of Protoneura, *P. peramans*, presented a remarkable adaptation of the sexes for mutual grasping during pairing, in that the bifid, superior, terminal, abdominal appendages of the male are received between bifid, mesothoracic processes of the female. The other species of this genus from this region show no (or less perfect) adaptations in this regard.

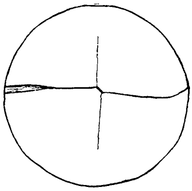

FIG. 1.—Surface view of a four-cell stage from above (about × 8).

Segmentation of the Ovum of Desmognathus fusca:[1] William A. Hilton, Cornell University.—During the last few years several amphibian eggs have been found which, from the few stages of development described, seem to indicate a meroblastic rather than a holoblastic method of cleavage. The first of these was reported by H. H. Wilder (1899) for Desmognathus, the second for Autodax, by Ritter and Miller, also 1899, and the third by Montgomery for Plethodon in 1901. In all of these forms only the later stages were observed.

As Desmognathus is very abundant in central New York, advantage was taken of the opportunity for a thorough investigation of the earlier stages.

The eggs are about 3.5 mm. in diameter and entirely devoid of pigment. The general appearance is creamy white except at the animal pole, which is chalky white. In this chalky white area the first division furrows make their appearance. The first and second furrows are at right angles (Fig. 1), but soon these lose this geometrical regularity and the later division lines may be very irregular.

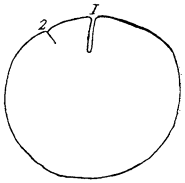

FIG. 2.—Section of four-cell stage, 1 and 2, first and second division planes (about × 8).

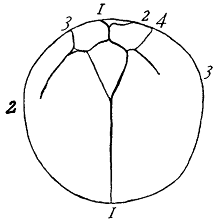

FIG. 3—Surface view of an eight-cell stage from the side, *1* and *2*, etc., first and second, etc., division planes (about × 8).

In the four-cell stage the first cleavage plane has cut somewhat deeper than the second, but neither has yet cut deeply into the central mass of yolk (Fig. 2). In the next stage there is no distinct equatorial groove. The eight-cell stage is gradually derived from the four-cell condition by the appearance of furrows between the two original ones. In the eggs of this stage which Wilder has studied (see footnote) two rather regular vertical planes of cleavage cut the egg at nearly right angles to the first division plane, but in a considerable number of eggs which I have examined, some of them living and others preserved, I only found one or two with such regular vertical cleavage planes; in some there was an approach to it, but in a number of others the eight-cell condition seemed to be gradually derived from the four-cell stage by the appearance of furrows which were hard to recognize as parts of vertical planes of cleavage. In the eight-cell stage the first furrow nearly encircles the egg, but the position of the first and the second is often so shifted that it is difficult to believe that they were ever at right angles (Fig. 3). At this time the animal pole may be divided into one or more distinct blastomeres, but the vegetative pole shows almost no signs of cleavage planes (Fig. 4).

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[1] Due to a slight misunderstanding, both Dr. Wilder and the author have been working on precisely the same problem. Dr. Wilder's results, if not published by the time this appears, will be published soon. In his paper he comes to the conclusion that the eggs of Desmognathus are holoblastic and not meroblastic in cleavage. His conclusions were reached by the study of the surface views, and I am very glad of the opportunity to confirm his observations by the aid of a few sections of early stages as well as a few surface views. I will leave a more detailed account of the early development of this animal for a later paper.

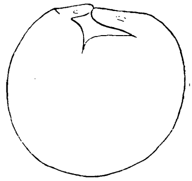


Fig. 4.— Section of an eight-cell stage (about × 8.)

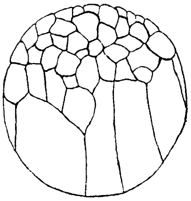


Fig. 5.— Surface views of a few-cell blastula from the side (about × 8).

As segmentation proceeds the surface appearances correspond in general with those of other amphibian ova (Fig. 5), but sections bring out the fact that the segmentation is shallow, and does not involve the whole thickness of the egg (Fig. 6). Later, however, when the surface appearance is like that of a fine celled blastula (Fig. 7), sections show that the segmentation has extended through the entire egg and that the cleavage in this stage is as truly holoblastic as in any other of the salamanders (Fig. 8).

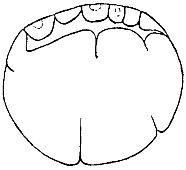


Fig. 6.—Section of a few-cell blastula (about × 8).

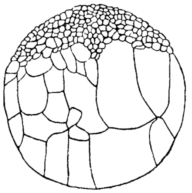


Fig. 7.— Surface view of a many-cell blastula from the side (about × 8.)

As the embryo increases in size the cell outlines in the yolk are lost, and if sectioned in this stage only, one would be justified in suspecting a meroblastic segmentation. This idea is helped by the fact that the growing embryo soon comes to occupy a position on the yolk strikingly like that of a fish embryo.

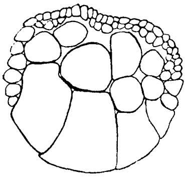


Fig. 8.—Section of a many-cell blastula (about × 8).

In a word, then, the segmentation of the ovum of Desmognathus is truly holoblastic, but the total cleavage is rather slow in appearing, and in the later stages of development the yolk mass becomes homogeneous by the disappearance of cell walls.

The Early Development of Dinophilus as Compared with that of the Annelids: James A. Nelson, University of Pennsylvania.—The ovum of Dinophilus segments into four cells, or macromeres, each of which gives rise by oblique alternating or "spiral" cleavages to five generations of smaller cells, or micromeres. The first three quartettes give rise to ectoderm. The posterior left hand member of the fourth quartette divides bilaterally and equally into two cells which later give rise to the mesoderm bands. The remaining cells give rise to the entoderm. This method of origin of the three germ layers is identical with that found in the Mollusca and the Polychæta. As in the two former groups the brain is formed from the first quartette, and the greater part of the trunk ectoderm from the posterior cell of the second quartette. In the details of the cleavage there is a striking agreement with that of the polychætous annelids. Cells arising from the first quartette identical in origin with the "primary trochoblasts" of the annelids, together with cells derived from the first and second quartettes, make up a cell row which very probably forms at least a part of the second ciliated band situated on the head of the adult, in a position corresponding with that of the prototroch of the annelid larva. Other details increase this resemblance. The symmetrical cell pattern known as "the cross" is formed by the same cells and at the same divisions as in the Polychæta, while in the divisions of the posterior cell of the second quartette bilateral symmetry appears at the same time and in the same cell as in several members of this group.

Such close agreement in the details of the cleavage, as well as in the fate of the corresponding cells with the conditions obtaining among the Polychæta, speaks strongly for a genetic relationship between this group and the Dinophilidæ, since cleavage patterns are inheritable, as well as other characters.

Organ-forming Germ Regions in the Eggs of Ascidians and Snails: Edwin G. Conklin, University of Pennsylvania.— The early development of ascidians and snails is of such a determinate character, even in the earliest cleavage stages, that it seems probable that a definite polarity and localization of materials exists in the unsegmented egg. A study of the eggs of these animals shows that this antecedent probability is realized in fact.

In the living eggs of the fresh water snails, Limnæa, Physa and Planorbis, one may readily observe the segregation of unlike materials of the egg before cleavage begins. Before maturation the nucleus can be seen in such eggs as a large, clear vesicle, while the rest of the egg substance is filled with yolk granules and is yellow in color. During the maturation divisions the nuclear vesicle is dissolved and its contents form a clear area surrounding the polar amphiasters. After the second polar body is formed this clear area spreads out as a disk and then as a cap which covers the upper two-thirds of the egg. The lower third of the egg which is not covered by this cap of clear protoplasm remains of a bright yellow color. These two portions remain distinct throughout the subsequent development, the clear area giving rise to the ectoderm and the yellow one to the endoderm and mesoderm. In these snails, therefore, the germ layers are visibly outlined in the unsegmented egg.

A somewhat similar localization of germinal materials, before cleavage, occurs in the eggs of certain ascidians. In *Cynthia (Styela) partita, Ciona intestinalis* and *Molgula manhattensis* the central yolk mass of the immature egg is surrounded on all sides by a peripheral layer of protoplasm. In the living eggs of Cynthia the central yolk is gray in color while the peripheral layer contains granules of yellow pigment; in Ciona the yolk is red, the peripheral layer clear and transparent; in Molgula the yolk is gray, the peripheral layer clear. As soon as a spermatozoon enters the egg this peripheral layer, together with the nuclear sap from the germinal vesicle, flows rapidly to the lower pole, at which point the sperm always enters. The yolk is left uncovered at the upper pole and here both polar bodies are formed. The protoplasm at the lower pole then moves up to a position just below the equator on the posterior side of the egg; and here the pronuclei meet and the first cleavage spindle arises. At the close of the first cleavage the greater part of the clear protoplasm moves into the upper hemisphere while the gray, yolk-laden protoplasm is largely collected in the lower hemisphere. In Cynthia the yellow pigment collects into a brilliant crescent, just below the equator on the posterior side of the egg; in Ciona and Molgula this crescent is clear and almost colorless. Owing to its color in Cynthia the substance of this crescent can be traced through the whole development until it gives rise to the muscle cells and the mesenchyme of the tadpole. The gray substance of the unsegmented egg gives rise chiefly to the endoderm, while the transparent protoplasm goes principally into the ectoderm. In these eggs, therefore, there is not only a localization of the material of the three germ layers before cleavage, but all the axes of the future animal are clearly established in the unsegmented egg.

An Experimental Examination of the Germ Regions of the Molluscan Egg: Edmund B. Wilson, Columbia University.— No abstract.

Polarity and Axial Heteromorphosis: T. H. Morgan, Bryn Mawr College.—The reversal of the polarity that is seen in axial heteromorphosis appears to give us an opportunity for an examination of the phenomenon of polarity itself, for, if we could determine the conditions that determine this reversal we might hope to gain some insight into the factors that determine the polarity. It is from this point of view that I offer the following observations on two species of planarians, *Planaria maculata* and *P. lugubris*.

If a planarian is cut in two at almost any level a new tail regenerates on the posterior end of the anterior piece and a new head on the anterior end of the posterior piece. It appears that the same material is doubly potent, being able at nearly every level to form a head or a tail. Something in the piece itself determines that a head shall develop at the anterior cut surface and a tail at a posterior cut surface. This "something" is what we call polarity.

I have found certain exceptions in the planarians to this rule. Occasionally a cross-piece develops a head at each end, and in *Planaria lugubris*, especially, when the tip of the old head is cut off just behind the eyes, another reversed head regenerates from its posterior cut surface.

In the few cases in which I got double-headed forms I was impressed by the fact that this occurred only when the cross-pieces were very short, and never occurred in long cross-pieces. This lead me to try making the pieces very short in order to see if I could obtain in this way more of these double-headed forms. This I found to be the case, and I have obtained from such pieces double-headed forms from every part of the body of *Planaria maculata*. It is clear, therefore, that the result can not be connected with the presence of any particular structure at the cut end. A number of different kinds of experiments, mainly with pieces having obliquely cut ends, seemed to show that the main factor in the production of the heteromorphic head is connected with the shortness of the piece. I suggest as a tentative hypothesis that this shortening of the piece reduces the strength of the polarity so that it comes to have less influence on the new part than certain innate tendencies of the material itself. There is reason to conclude, as I have stated, that the new material that develops over the cut surface has the power of producing either a head or a tail. If now the polarity is reduced, or removed, that one of these two tendencies which is stronger will have a chance to assert itself. In the case of *Planaria maculata* the tendency to produce a head seems stronger than the tendency to produce a tail, hence the appearance of the heteromorphic head in the short cross-pieces, in which the polar influences fail to act. This conclusion I hold subject to future revision when we have gained more light as to the nature of the so-called polarity itself.

In *Planaria lugubris* I had found that when the head is cut off just behind the eyes a heteromorphic head is produced on the posterior end of the old head. From this result I confess that I anticipated that in this worm it would be even easier than in *P. maculata* to obtain double-headed forms from short cross-pieces. To my surprise I found on the contrary that these double-headed forms do not arise except in a few cases in which the cross-pieces have come from the region immediately behind the old head. Most of the other short cross-pieces produce a head and a tail, but in a small number of cases the structure that develops at the anterior end appears to be a tail. It would be difficult to determine with absolute certainty whether this anterior pointed structure is a heteromorphic tail or an undeveloped head, unless the pharynx were to develop. In one case a pharynx appeared in the new part at the anterior end, and another in the new part at the posterior end. In both the new pharynx pointed outwards, *i. e.*, towards the tip of the new part, hence there can be little question that the new structure is really a heteromorphic tail.

It appears in *Planaria lugubris* that while the material at every level has the double potency of producing a head or a tail according to which end of the piece it comes to lie at, yet in very short pieces from the middle and posterior regions of the body a double-tailed form may arise. We must suppose, therefore, on our hypothesis, that while in this species also the material is totipotent, yet when the determining influence of the polarity is removed the stronger tendency is to produce a tail, while in *Planaria maculata*, as we have seen, the stronger tendency is in the other direction.

In *Planaria lugubris* it has been necessary to assume that the most anterior part of the body has a different predisposition than has the rest of the body, since in the former a double-headed piece may develop and in the latter a double-tailed form. This result finds a parallel in certain other cases that I have observed in the earthworm and tadpole.

If an earthworm is cut in two behind the region of the gizzard there often develops from the anterior cut surface of the posterior piece of the worm a heteromorphic tail. In this case the posterior part of the worm is not a short piece, and yet it is worthy of note that this region has practically the same structure throughout. This may mean that the conditions are fundamentally the same as those in the short cross-pieces of the planarian, and if so this may throw some light on the phenomenon of polarity itself.

It has also been shown in the earthworm by Hazen that from the posterior cut surface of a short piece of the head end a heteromorphic head may develop. Here we must assume that the tissues are predisposed to form a head, while in the posterior region they are predisposed to form a tail, and in both when the polar influences are removed these structures appear. It has been shown by Harrison in the tadpole that a tail-like outgrowth develops from the anterior cut surface of the tail. I have tried to show that this outgrowth is really a heteromorphic tail. Here again it is noticeable that the old tail has practically the same structure throughout, hence possibly, as in the earthworm, there may be a decrease in the polarity and the consequent development of a heteromorphic structure.

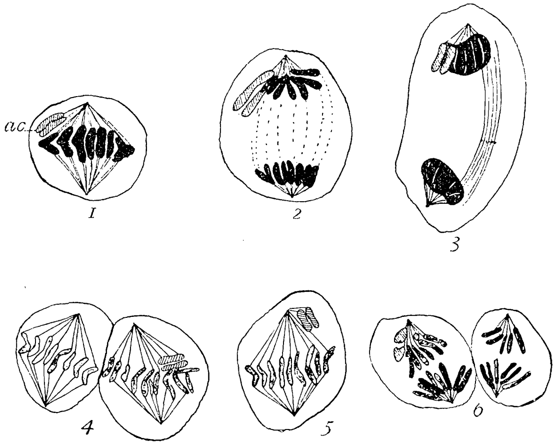
These considerations are tentative, and possibly premature; but the facts give us at least some grounds for the hope that the problem of polarity may not be beyond the reach of further analysis.

The Development of the Germ Layers in a Nudibranch Mollusc: Dana B. Casteel, University of Pennsylvania. — The cleavage of the egg of the nudibranch, *Fiona marina*, is of the spiral type well known for molluscs. From the mesentomere (4 d) arises the primary mesoblast and also enteroblasts, these latter being concerned in the formation of the intestine. Secondary mesoblast is formed from the third quartet of ectomeres in a manner similar to its formation in Physa and Planorbis. Two cells in each anterior quadrant sink below the surface into the cleavage cavity and by division there form two bands of cells on the sides of the anterior end of the gastrula. These elements later take part in the formation of the muscles of the velum, a larval organ, and are thus truly "larval" in character.

The anal excretory organ, characteristic of opisthobranch larvæ, is undoubtedly of ectodermal origin in Fiona. It arises from one large and several small third quartet cells of the right posterior quadrant which, after torsion begins, are carried farther to the right side and above the anal opening. The larva also possesses additional organs of excretion, two in number, lying bilaterally in the anterior region of the body cavity. These, the "nephrocysts," are composed of but a few large vacuolated cells which contain concretions and fluid excreta. The origin of these cells has not been determined definitely, but they are probably derived from the mesoderm.

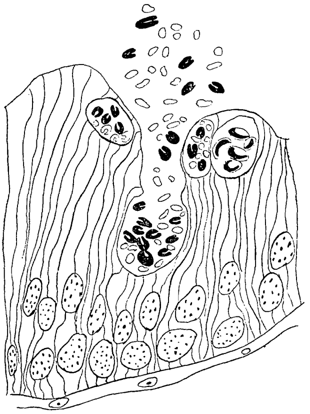
A Pair of Giant Nerve Cells of the Squid: Leonard W. Williams, Brown University. — No abstract.

The Function of the Accessory Chromosome in the Spider: Louise B. Wallace, University of Pennsylvania.— In the spermatogenesis of insects a number of authors have described a peculiar chromosome which has been called by various names. While these all agree in being unlike the ordinary chromosome, there seems to be sufficient disagreement to subdivide them into two groups. Montgomery's "chromatin nucleolus" and Paulmier's "small chromosome" are probably homologous and these authors have suggested that they may represent degenerating chromatin. McClung's "accessory chromosome" in Orthoptera



is too well developed to allow of such an explanation and since it divides in the second maturation division only and is thus distributed to but one-half of the spermatids, he regards it as a sex-determinant.

In the spider *Agalena nævia*, the peculiar chromosome closely resembles the one described by McClung and therefore I adopt his term but my results differ from his in regard to its distribution. I am convinced that, although split longitudinally, it takes part in neither of the maturation divisions and that, therefore, only one-*fourth* of the resulting spermatids possesses it. Such a condition would hardly favor the idea of sex-determination. Figures 1, 2 and 3 show spermatocytes of the first maturation division and Figures 4, 5 and 6, spermatocytes of the second maturation division.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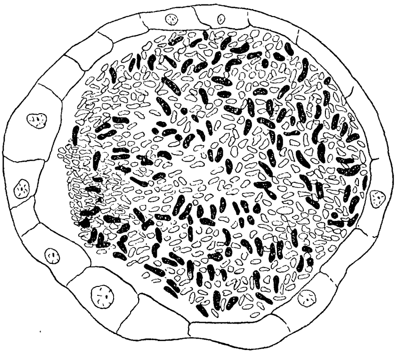
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In nests of maturing spermatozoa are found cells undergoing degeneration (Fig. 7) and these occur in great numbers in the testis and also in the ducts (Fig. 8) together with the much smaller number of ripe spermatozoa. This fact leads me to suggest that possibly only those spermatids which contain the accessory chromosome develop into functional spermatozoa and that the remaining three-fourths never reach maturity. If this interpretation be a true one, a parallelism could be drawn between the development of the spermatozoön and of the ovum, since in the latter only one of the four oötids develops into a ripe ovum, the other three being thrown off as polar bodies and later degenerating.

The Lamellibranch Nervous System: Gilman A. Drew, University of Maine.— The nervous system of the giant scallop, *Pecten tenuicostatus*, is greatly specialized, and the size of the animal makes it possible to study it by dissection as well as by serial sections. The cerebral and pedal ganglia are small, owing no doubt to the reduction of the parts they supply, and the visceral ganglia, supplying the large adductor muscle and sending a large number of nerves to the borders of the mantle, are very large and composed of distinctly marked regions. The pallial nerves that follow along the borders of the mantle lobes near the bases of the tentacles and eyes, present the structure of ganglia and supply nerves to the tentacles and eyes, which are very abundant in this form. The need for such ganglia is apparent, and their presence instead of a further complication of the visceral or cerebral ganglia indicates the ease with which such centers may be established when need arises.

The fact that the pallial nerves, that here show the structure of ganglia, are joined at intervals for nearly their whole length by nerves from the visceral ganglia, while only a very few nerves are sent to them from the cerebral ganglia, and these only to their extreme anterior ends, is taken as an indication that the loss during development of the anterior adductor muscle is accompanied by a suspension in the growth of other anterior portions, and that the bulk of the animal if formed by the excessive growth of the posterior portions.

The relation of the nervous systems of other lamellibranchs was also discussed.

The Early Stages in the Development of Ophiothrix Fragilis: E. W. MacBride, McGill University.— Comparatively few and scattered notices are to be found in zoölogical literature with reference to the early development of Ophiuridea and in a preliminary notice like the present communication, it will only be necessary to refer to one of them. In 1891 Russo[1] published an account of the formation of the layers in the embryo of the viviparous *Amphiura squamata*; and in that paper he made the startling statement that in *Amphiura squamata* the endoderm was formed by delamination from the inner ends of cells forming the wall of a hollow blastula, and that, further, the cœlomic sacs appeared as cleavage spaces in the midst of masses of mesenchyme cells.

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[1] Le prime fasi di sviluppo nell' Amphiura squamata — *Bollettino della Società in Naturaliste* in Napoli. Vol. 5, 1891.

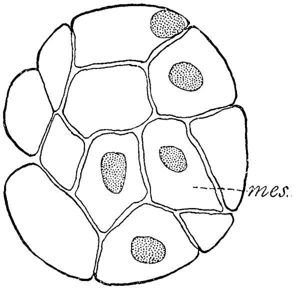

Fig. 1.—Section through the segmenting egg *mes.*, internal cells separated by tangential division.

Such fundamental differences between the developmental processes in this form and those in all other Echinodermata, were hardly to be credited without ample confirmation, especially when it is recollected that Amphiura squamata is not a favorable object for study owing to the difficulty of obtaining the earlier stages in quantity.

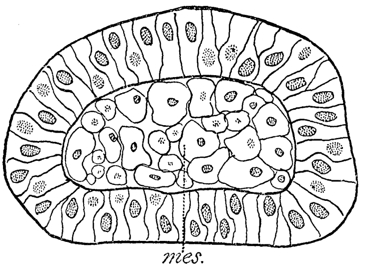

Fig. 2.— Section through embryo at the close of segmentation.

For this reason I selected the common British form, *Ophiothrix ragilis* for study, and, during a visit to the Plymouth Biological Station in 1898 I artificially fertilized a number of the eggs and reared some of the larvæ through the entire period of development up to and including the metamorphoses, the whole occupying about three weeks.

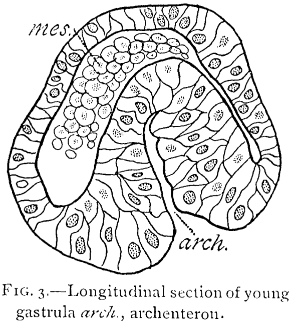

Fig. 3.—Longitudinal section of young gastrula *arch.*, archenteron.

The egg of *Ophiothrix fragilis* is very minute, being less than .1 mm. in diameter, and is quite opaque so that in order to follow the earlier stages of development it is necessary to use serial sections.

As shown in Figure 1, the result of segmentation is not as in other Echinodermata, a hollow blastula, but a solid morula. From a comparison with one another of my preparations, it appears that the egg at first divides into a few blastomeres, which are arranged around a vestigial, or perhaps we might say virtual blastocœle, and that as development proceeds this blastocœle swells but is kept continually filled by cells produced by tangential divisions of the peripheral blastomeres. At the conclusion of segmentation, the embryo strikingly recells a cœlenterate planula, as shown in Figure 2.

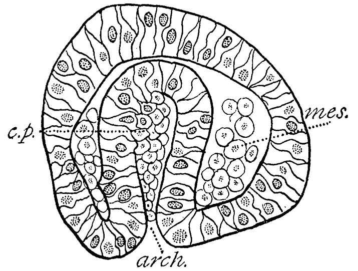

Fig. 4.—Longitudinal section of older gastrula *arch.*, archenteron *c. p.*, cellular plug.

The interior mass of rounded cells, however, does not constitute the endoderm, for, in the next stage (Fig. 3) a regular invagination has made its appearance, giving rise to an archenteron, which is, however, two or three cells thick on one side. The interior cells of the former stage are seen to occupy the space between archenteron and ectoderm, homologous with the segmentation cavity of other forms. In the completed gastrula a curious plug of cells is seen projecting into the archenteron which is no doubt the remains of the thickened side of the archenteron of the younger gastrula (Fig. 4).

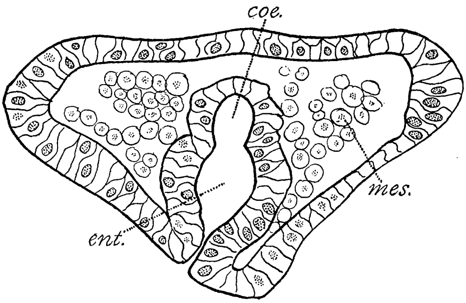

Fig. 5.— Longitudinal section through an embryo two days old *cœ.*, cœlom *ent.*, enteron.

When the embryo has attained the age of two days, the rudiment of the cœlom appears as a vesicle at the anterior end of the archenteron exactly as it does in the embryos of Asteroidea. At the same time the embryo takes on a shape which may be described as roughly triangular. The two basal angles of a triangle (Fig. 5) are really the rudiments of the first two arms of the larva, which throughout the whole larval existence are much longer than the rest, and are the most important organs of locomotion. The cells which form the interior mass at the close of segmentation are now seen to be destined to form the supporting calcareous rods for these arms, and hence we may attribute the leading peculiarity of the development, *viz.*: the appearance of a solid morula instead of a hollow blastula, to the extremely precocious formation of the skeletogenous cells for these arms.

On the Homologies of the Archenteron and Blastopore in Vertebrates: Charles S. Minot, Harvard University.— No abstract.

Medusa Fauna of the Bahamas: Alfred Goldsborough Mayer, Brooklyn Institute of Arts and Sciences.— The medusa fauna of the Bahamas is poor in comparison with that of the Tortugas, Florida. The writer secured ninety (90) species of Hydromedusæ, Scyphomedusæ, Siphonophoræ and Ctenophoræ at the Tortugas, while only forty-three (43) species were found at the Bahamas. What is more interesting, the relative abundance of specific forms is quite different in the two regions. The commonest medusa during the summer months at the Tortugas, *Pseudoclytia pentata*, is not found at the Bahamas, and the commonest medusa during the summer months at the Bahamas, *Lymnorea alexandri*, is not found at the Tortugas.

Altogether, of the forty-three species of Bahama medusæ, twenty-three (23) are about equally abundant on the other side of the Gulf Stream at the Tortugas. Sixteen are more abundant at the Bahamas than at the Tortugas, while four are more abundant at the Tortugas. This is accounted for by the following facts: The Tortugas lie to leeward of the Gulf Stream and the extraordinarily rich pelagic life of the great current is constantly driven upon their shores, while the Bahamas lie to the windward of the stream and their local fauna is not reinforced by creatures characteristic of the great current. There is, however, something more than a mere concentration of individuals at the Tortugas, for a surprising number of characteristic species appear to be confined to this region alone. Moreover, at the Tortugas, we have a small land mass surrounded by pure deep ocean water, while at the Bahamas we find a vast area of shallow flats covered mainly by coralline mud, forming veritable submarine deserts covered only with a sparce growth of coralline algæ and a few scattered clusters of coral reefs and gorgonians. The water over these shallow banks is almost as deficient in life as is that of the desert bottom itself, very few Sagittæ, Salpæ or Crustacea being found, and among the Medusæ only representatives of the Gonionemidæ and Lymnorea are abundant. Indeed, the water of these shallow banks is usually charged with a flocculent mass of silt which adheres to pelagic animals, and appears to be rapidly fatal to them. The deep water regions of the Bahamas, however, such as the tongue of the ocean, or the water to the eastward of Great Abaco Island, are rich in pelagic animals which appear to be free from silt and in good condition. This water of the deep areas must, however, be often driven over the shallow banks by the winds, and its life be thus destroyed.

It is found that Olindias is closely related to Gonionemus, for in its ontogeny it passes through a stage in which all of the tentacles arise from the side of the bell, and are sucker-bearing as in Gonionemus. *Euchcilota paradoxica* is the only Leptomedusa known which produces an asexual generation of Medusæ by a direct process of budding. These daughter Medusæ are derived from both ectoderm and entoderm of the gonad of the parent, as is the case in the Sarsiadæ and in Hydroids. On the other hand, the Medusæ buds found upon the manubrium of *Bougainvillia niobe* are developed entirely within the ectoderm, the entoderm remaining inert and passive during the growth of the bud, its limiting membrane being unbroken, and no connection ever being established between the gastro-vascular cavities of the bud and the parent. In *B. niobe*, however, the ectoderm of the manubrium is of considerable thickness, affording abundant material for the formation of the bud. It is possible, therefore, that this peculiar method of formation of medusa buds from the ectoderm, which has been observed in *B. niobe* by us, and in *Rathkea octopuncta* and *Lizzia clappadei* by Chun, may be due to a gradual process favored by the thickness of the ectoderm which may have prevented the deep-lying entoderm from taking an equal share in the formation of the bud until finally it has come to remain passive throughout the period of formation of the bud, as in *B. niobe*.

Medusæ produced from ectoderm alone may, therefore, be phylogenitally homologous with Medusæ produced by the more primitive and universal coöperation of both ectoderm and entoderm.

Among the new forms discovered, *Parvanemus degeneratus* is the most degenerate free-swimming hydroid medusa yet described. It lacks tentacles, sense organs and peripheral vascular system. It swims, however, with great activity, but is short lived.

Correlation as the Basis for Selection in Lepidoptera: Henry E. Crampton, Columbia University.— Read by title.

Exhibition of a Cat, Showing Abnormal Placement of Viscera: C. M. Clapp, Mount Holyoke College.— No abstract.

The Origin and Function of the Medullary Sheaths of Nerve Fibres: Porter E. Sargent, Browne and Nichols School, Cambridge.— No abstract.

Demonstration of Pulsatile Anterior Lymph Hearts in Young Tadpoles: Henry McE. Knower, Johns Hopkins University.— No abstract.

Excretory Activities in the Nuclei of Gastropod Embryos:[1] O. C. Glaser, Johns Hopkins University.—The primitive urinary bodies of the larva of *Fasciolaria tulipa* attain great size and are very favorable objects for study. They originate as two pear-shaped patches of highly vacuolated ectoderm at the sides of the definitive mouth. On account of their connection with the velar fold they are later carried outwards from the wall of the embryo and ultimately hang down from the under side of the velum.

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[1] The material on which this work was done was collected during three summers in North Carolina. I am deeply indebted to the Hon. Geo. M. Bowers for the courtesies of the Beaufort Laboratory of the Bureau of Fisheries.

Between the two extremes in development mentioned, the cells composing these bodies increase in size, in number by addition, and undergo a period of active excretion. Early in this period the nuclei divide amitotically, and the cells become polynucleated. The nuclei are granular, very irregular in outline, and each one has at least one nucleolus surrounded by a clear area. In addition the cells are characterized by their highly vacuolated condition (Fig. 1).

In sections through these nuclei, before and after amitosis, the chromatin is arranged in an irregular network (Fig. 2 A, B, C). The nucleolus (*nl*) has a different staining reaction, and is probably a typical plasmosome. The halo surrounding it, instead of being circular or oval in outline, as it appears to be in whole mounts and in optical sections, is highly irregular, its outline projecting in finely attenuated processes into the body of

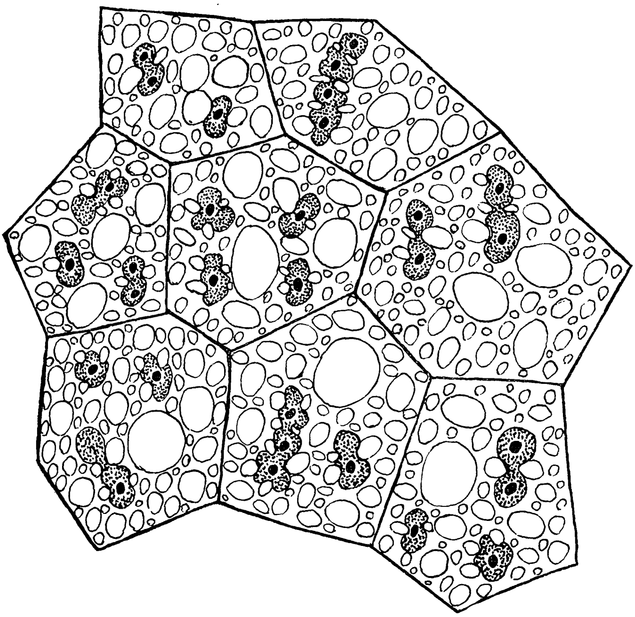

FIG. 1 — Surface view of part of external kidney.

the nucleus. These processes are so delicate and the granules bounding them so small in comparison with the chromatin granules in the network, that they are invisible except in sections. The location of large chromatin granules continuous with the nuclear reticulum, in the indentations of the halo, explains its circular appearance in entire preparations, because these granules are the only parts of the outline visible. They also afford an explanation of the irregular outline itself, for if we imagine a sphere of liquid to proceed out from the nucleolus in all directions, any larger objects with which it might come in contact would, after yielding as much as possible, detain the surface at certain points, allowing it to advance only where there is no resistance, *viz.*, between the larger granules. In many cases the projections of the halo end distally in bulges or vacuoles (A, *vac*) which, apparently through the agency of the larger granules of the nuclear reticulum, become constricted off and may afterwards be found loose in the nucleus (A, B, *vac′*), from which they may finally escape (C, *vac″*). In other cases the projections of the halo may break through the wall of the nucleus before the vacuoles separate (B, *vac″*).

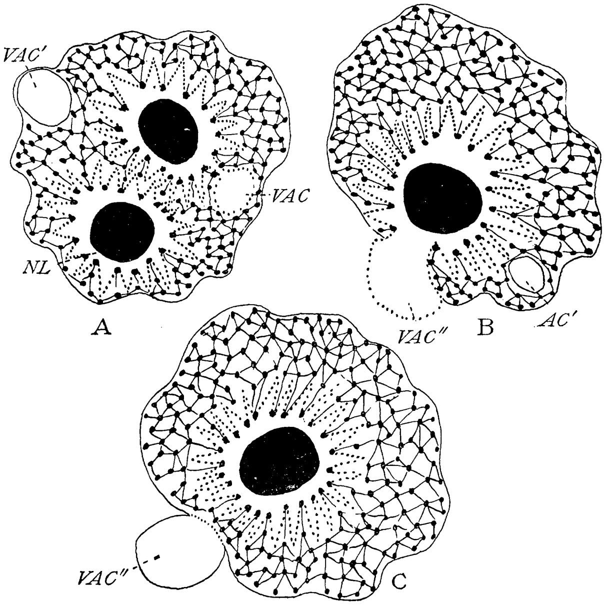

FIG. 2.— Sections of nuclei of excretory cells.

These phenomena strongly suggest an excretory activity, and this suggestion is strengthened by our knowledge of the behavior of amitotically dividing nuclei in other animals, but especially by the results of R. W. Hoffmann on the behavior of the nuclei and nucleoli in the large macromeres of the embryos of Nassa mutabilis. Complete proof, however, that the activities described in the sub-velar masses of Fasciolaria are really the exhibition of an excretory process, is found in a chemical analysis of an aqueous extract of these bodies. Such an extract analyzes like a dilute solution of urea.

Double Reproduction in the Medusa Hybocodon prolifer: H. F. Perkins, University of Vermont.— Hybocodon is familiar to American biologists as a singularly asymmetrical jelly-fish found along our coast in the early spring. Of the four radial canals only one is continued beyond the bell in a tentacle.

The method by which this medusa has been described as reproducing its kind is by developing, upon the bulbous base of this solitary tentacle, gemmiferous buds. These, when mature, become detached from the parent and swim away as free jelly-fish. Only the one tentacle is developed upon these buds, and at the time of liberation the base of this tentacle frequently carries maturing buds of a second generation.

While this is a rapid and efficient means of propagation, it is not the only one. In addition to this asexual process, a sexual process is also present. Eggs or sperms are produced within the gonads which surround the manubrium, and these develop within the tissue to the condition of tentacled actinula larvæ. Thus the adult Medusæ give origin to two sorts of offspring, one by gemmation, the other by sexual production of viviparous young. This in itself is not anything extraordinary, but it is a matter of interest that the two processes are found taking place simultaneously in the same individual, and that this coincidence does not lessen the rapidity with which the embryo jelly-fish are produced on the tentacle bulb. The fact is of interest only as showing that the reproductive activities of Medusæ are even more unrestricted than we have realized.

The sexually produced larvæ of Hybocodon mature upon the wall of the parent manubrium, attached to this member, after the earliest stages, by a slender connecting stalk. Ten tentacles appear while the larva is still a spherical mass, and as they lengthen assume a direction pointing away from the point of attachment. The mouth and oral tentacles of the actinula are developed after liberation at the pole which was, during the attached period, next to the parent.

The Development of the Heart and Branchial Blood Vessels of Ceratodus: William E. Kellicott, Columbia University.— No abstract.

Regeneration in Scyphomedusæ: Chas. W. Hargitt, Syracuse University.— Notwithstanding the remarkable development and scope of experimental zoölogy during the past decade, extending to members of every phylum from Protozoa to Vertebrata, comparatively little has been done directly upon any of the Medusæ, and almost nothing upon Scyphomedusæ. The incidental reference of Haeckel to such a tendency among certain of these organisms is hardly more than a hint, with nothing whatsoever as to details. Such is also the case with the later work of Eimer and Romanes on the nervous system of the Medusæ, at least as it pertains to problems of regeneration, though painstaking and important in its bearings on problems of locomotion and co-ordinated activities. More recently Uexküll has also reviewed some of this work, and while differing in many respects from that of his predecessors as to conclusions, leaves untouched the subject of regeneration.

The series of experiments of which this abstract furnishes the barest outline was undertaken with a view to ascertain the comparative capacity of Scyphomedusæ to reproduce lost parts, such as bits of the various parts of the body which might be lost by the usual exigencies of the struggle of life. The experiments comprised some three phases of regenerative energy:— First, the general ability to recover from such injuries as rents of the umbrella, etc.; second, regeneration of such organs as oral appendages; third, ability to regenerate such specialized organs as the sensory bodies.

Concerning the first, it required but few experiments to determine very clearly the existence of such a capacity, though its progress was somewhat more slow than had been anticipated. Various rents of the umbrella were soon healed, but excisions of the margins of the body were regenerated much more slowly.

Concerning the second class, the responses were similarly slow. An excised oral arm required several weeks to completely regenerate, as was also the case with excised portions of the gastric pouches.

Concerning the third class I had entertained some doubt, namely the power to reproduce the more specialized organs, such as rhopalia or sensory bodies. The experiments were an agreeable disappointment, as these organs were quite as promptly regenerated, if not indeed more so than had been the case with the former. In some cases the first signs of regeneration were noted within five days of their excision, and in from eight to twelve days their functional power was clearly recovered, as was proved by details of experimentation impracticable to describe here. The associated organs, such as lappets, hood, etc., were also quite as fully regenerated as the other.

Histological examinations show beyond any doubt the operation of typical histogenic processes, various phases of the regenerating organ being easily traceable from stage to stage to perfect maturity of form and structure.

In earlier experiments of a similar sort made upon Cyanea and Aurelia by the writer it was found impossible to maintain the normal vitality of the animals for sufficient time to secure any conclusive results. Rhizostoma, however, lends itself most remarkably to experimentation of various sorts and for continuous periods of from four to six weeks without material loss of vigor or regenerative power. It was found, however, that this was somewhat dependent upon the size and, presumably, age of the specimens. Those of large size, 75 to 125 mm. in diameter, proving much less hardy under an aquarium environment than specimens of smaller size; though very small specimens also proved less satisfactory. Specimens of from 40 to 60 mm. in diameter proved much the better, not only from the apparently greater vigor, but also in convenience for experimentation and observation.

The experiments clearly prove the capacity among these organisms for regeneration of organs or parts of organs, from the more generalized sort to the most specialized, and that with approximately similar readiness.

A New Generic Type of Polygordidæ: J. Percy Moore, University of Pennsylvania.—The annelid referred to is known only from a couple of fragmented specimens found in association with marine Oligochæta on Cape Cod. Like Polygordius it has a slender, elongated form, an acutely conical prostomium bearing a pair of prominent, slightly articulated, apical tentacles, a round, open mouth, and above it a pair of deep, ciliated, sensory pits. The segments are very obscurely indicated externally in the anterior region but are clearly defined at the caudal end. The body wall exhibits the same succession of layers as in Polygordius; and internally are found a similar digestive tract with eversible proboscis, divided of the cœlom by transverse intersegmental dissepiments and dorsal and ventral longitudinal mesenteries, an oblique muscle band supporting the metameric gonads, and an epidermal nervous system ending anteriorly in a bilobed cephalic ganglion. In all these and other characters the worm resembles Polygordius, but in three important respects differs from that genus.

By an arrangement which can be described as a shortening of the oblique muscle sheet, the thick layer of longitudinal muscles is folded on each side in the form of a longitudinal ventrolateral ridge in which the muscle fibres assume (in transverse section) a radial arrangement and undergo certain structural changes. Thus is approached the condition found in many of the more primitive Polychæta and the manner in which the segregation of the dorsal and ventral longitudinal muscle tracts of annelids may have occurred is indicated.

At the caudal end the last ten or twelve somites are setigerous. Two of these bear a pair of seta on each side but the others only a single slender, vitreous, capillary seta, which arises on each side from the place of insertion of the oblique muscle and curves over the back for a distance nearly equalling the diameter of this region.

The anal segment or pygidium shows no enlargement nor other peculiarities exhibited by most species of Polygordius. There are no marginal papillæ or special appendages of any sort, but the pygidium continues the general outline of the rest of the caudal region to the anus. The caudal setæ evidently serve the same purpose as the bulbous enlargement with its papillæ of Polygordius in anchoring the posterior end of the worm. For this worm the name of *Chætogordius canaliculatus* is proposed. Its chief interest is that it somewhat bridges the gap between Polygordius and the Polychæta and partially confirms the view expressed thirty years ago by McIntosh that Polygordius finds its nearest polychæte relations in the Opheliidæ.

The First Steps Toward Degeneration in the Parasitic Copepods: Charles B. Wilson, State Normal, Westfield, Mass.— No abstract.

Gynnandromorphous Ants; W. M. Wheeler, American Museum of Natural History.— No abstract.

Trematode Parasites of American Frogs: H. S. Pratt, Haverford College.— Up to the present time the following species of trematodes have been found in American frogs:— *Halipegus* (*Distomum*) *ovocaudatus* Vulpian in the mouth and eustachian recesses; *Hæmatolæchus* (*Distomum*) *longiflexus* Staf., *H. similiplexus* Staf., *H. breviplexus* Staf., *H. varioplexus* Staf., and *Ostiolum* (*Distomum*) *formosum* Pratt in the lungs; *Pleurogenes* (*Distomum arcanus* Nickerson encapsuled in the pylorus and the liver; *Distomum quietum* Staf. *Cephalogonimus americanus* Staf., D. retusum Leidy, and Holostomum nitidum Leidy, in the small intestine: *Diplodiscus* (*Amphistomum*) *subclavatus* Gœze in the rectum; *Gorgodera* (*Distomum*) *amplicava* Looss, *G. simplex* Looss, *G. attenuata* Staf., and *G. translucida* Staf., in the urinary bladder; *Distomum tetracystis* Gal. encapsuled in the muscles of the throat; and *Monostomum ornatum* Leidy in the body-cavity.

The Structure and Development of the Compound Eye of the

Bee: E. F. Phillips, University of Pennsylvania.— The ommatidia which make up the compound eye of the honey bee are each composed of a crystalline cone of four cells and a rhabdome surrounded by eight or occasionally nine retinular cells. Each ommatidium is sheathed by two kinds of pigment cells, the inner pigment cells, two in number which surround the base of the crystalline cone and the outer pigment cells, twelve in number which extend the entire length of the ommatidium. Each retinula cell sends in a process to the retinular ganglion which has the property of a nerve fibre. The nerve fibres of the eye are differentiated portions of the retinular cells which send in fine branches to the rhabdome, which is probably the nerve ending of the eye. There is no connection between the crystalline cone and the rhabdome and the cone has not a sensory function.

The ommatidia develop from a single layer of thickened hypodermis and the region of the compound eye is marked out in the unhatched larva. The first indication of ommatidia is the grouping of cells with a distinct boundary in young larvæ. The cells of these groups become differentiated until each group is composed of a spindle-shaped mass with large nuclei, surrounded by numerous cells with smaller nuclei. The central spindle forms the retinula and the rhabdome is early visible as a clear space at the outer surface. The crystalline cone arises from the sides of the retinula and the pigment cells are still farther out. The ommatidium is formed as a morphological invagination of the hypodermis as was held by Watase. The rhabdome and crystalline cone are formed as intracellular secretions and the lens is secreted by the inner pigment cells whose nuclei in the young pupal eye are distal to the cone and afterward migrate to the base of the cone.